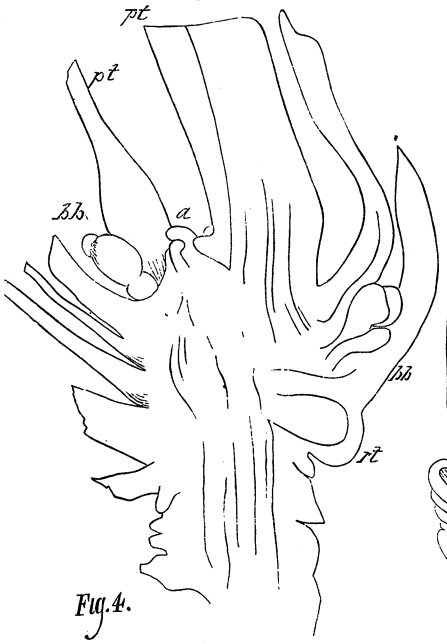

Fig. 4.

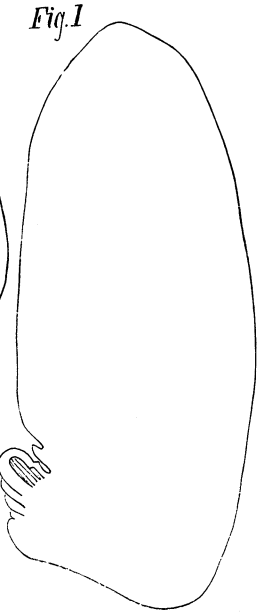

Fig. 1

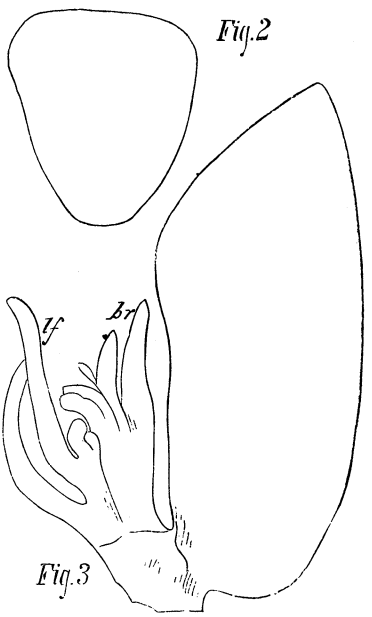

Fig. 2

Fig. 3

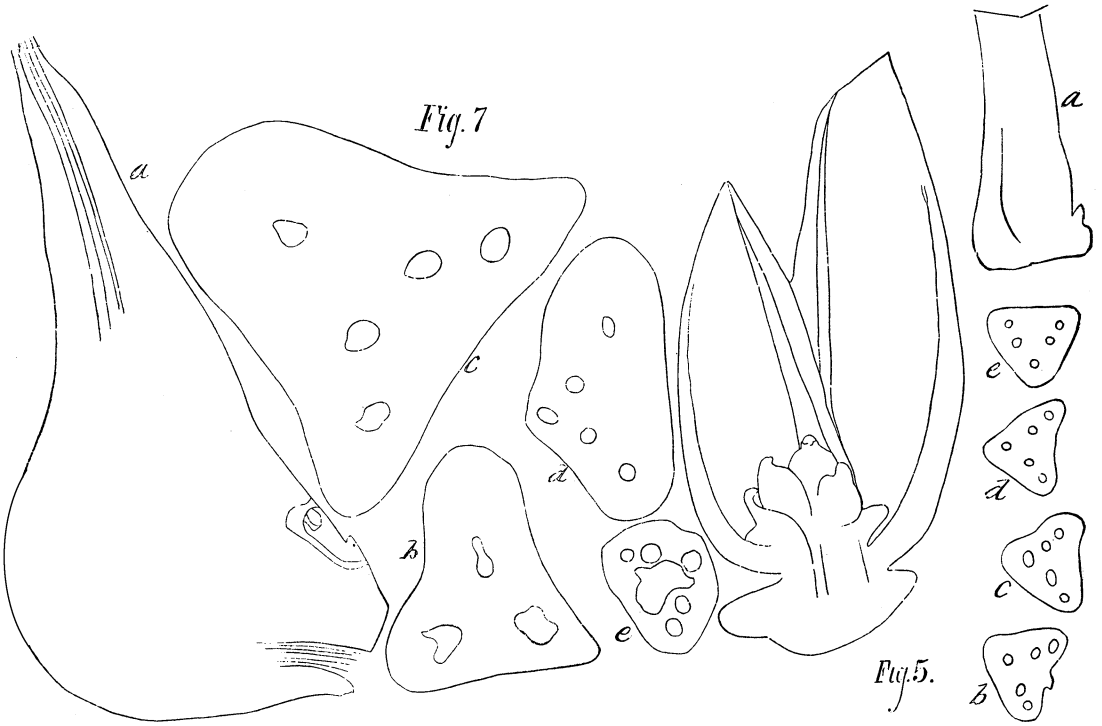

Fig. 7

Fig. 5.

DEVELOPMENT OF THE ROOT-STOCK OF DICENTRA.

ering the whole segment but tapering below, in the upper node extending down to fill the gap above the sporangium ; at *c*, *c*, lateral tubes, in the lower node dilating below, in the upper, larger above, on the right and on the left nearly obsolete ; at *d*, *d*, regular tubes from the bract. The group of three tubes arises from *one bract-node* of the leaf. The exact development of cells at the base of this node is not known ; it seems to have some peculiarties which require investigation with fresh specimens. Figs. 6 and 7, nuclei with faint striae.

EXPLANATION OF PLATE XX, *Ch. excelsa*.—A, plant natural size. Fig. 1, stem and verticil, showing variable cortex-spines and stipules. Fig. 2, a section of the stem, showing slight deviation from a regular diplostichous type. Fig. 3, two nodes of a leaf, with verticillate bracts. Fig. 4, terminal node of leaf with an elongated, naked, two-celled tip. Fig. 5, tip of one of the bracts (magnified 250 diameters). Fig. 6, one of the mature sporangia, showing the elongated neck, and short, blunt cells of the coronula. Fig. 7 and 8, mature muclei, with 15—16 sub-acute angles. The figures (except Fig. 5) are magnified 35 diameters.

EXPLANATION OF PLATE XXI. *Ch. aspera*.—A, a male plant of the ordinary form (from Long Island), natural size. B, a female plant of var. *Macounii*, natural size. Figs. 1–3, from normal form (*macroptila*). Fig. 1, a portion of the stem, showing the irregular formation of the cortex, and the base of a verticil showing the large stipules. Fig. 2, portion of a leaf bearing sporangia, with long verticillate bracts ; coronula somewhat divergent. Fig. 3, portion of a leaf from the male plant. Figs. 4–6, from var. *Macounii*. Fig. 4, stem, verticil and portion of leaf of a female plant, showing small blunt spines, irregular cortex, minute stipules, minute bracts, connivent coronula and the torsion of the leaf. Fig. 5, part of leaf of male plant. Fig. 6, terminal node of a leaf (not always with a *two*-celled naked segment, but often only one-celled). Fig. 7, a cluster of bulblets from the rootlets of a European specimen. These consist of a simple sack filled with starch granules of varying size, the largest averaging 70 μ in diameter, the interstices between the larger granules being densely packed with smaller ones. Fig. 7, *a*, one granule magnified 100 diameters, showing a black cross with polarized light. Figures all magnified 40 diameters.

EXPLANATION OF PLATE XXII, *Ch. fragilis*.--A, plant natural size with bulblets at the underground nodes. B, a verticil and leaf magnified 25 diameters; 8 and 9, and 8*a* and 9*a* showing two terminals, the single-celled one more common. C, an enlarged bulb, and a section showing numerous cells filled with starch granules. D, a node beginning to deposit starch in the nodal cells. The starch seems to form in the extremities of the main tubes of the stem, in the base of the leaves and in the cells surrounding the base of each leaf, thus giving rise to a very complicated tuber. The thickening of the tuber around the base of the leaves is well shown in the magnified tuber. Fig. 10, a nucleus.

On the Development of the Root-stock of Dicentra cucullaria.

By JOSEPH SCHRENK.

(Plate XXIII.)

When we examine this plant in December or January, we find that many of the singular bulblets of which the bulk of its subterranean portion consists, begin to push forth buds from near their bases, on the inner side (toward the axis). At this time we find these buds in various stages of development: some are mere protrusions above the epidermis, others show plainly one or two rudimentary leaves surrounded by several scales or bracts (Plate XXIII, Figs. 1 and 3). The more advanced buds have an elongated axis beset with large membranaceous bracts, which, overlapping one another, envelop the axis. In the axils of these bracts there are found miniature bulblets, either singly or in clusters, shaped like the large ones from which the buds have started; only at their upper end we discover a rudimentary, but very plainly tripartite leaf-blade incurved toward the axis (Fig.

4, *bb.*, and Fig. 5). This rudimentary blade attains a greater size and development on those bulblets that grow at the top of the axis.

In every vigorous shoot we find, near the end of the axis, one, or often two leaves which are so far advanced in growth that the entire structure of the full-grown *Dicentra* leaf is plainly discernible. They even have a greenish tinge, although closely wrapped up by the bud-scales and growing under ground. But besides having an almost fully developed lamina, such perfect leaves are remarkably different in regard to their petioles from the ones with only rudimentary blades. With these, the bulblet itself is simply a greatly enlarged, roundish-triangular leaf-stalk, bearing at its top a mere vestige of a lamina, while the well-developed blade of the former is borne on an elongated, typical petiole, which only at its very base presents an evident, though comparatively slight swelling (Fig. 4, *pt.* and Fig. 6, *a.*) At the flowering time (in April), when the leaf-blades have fully expanded this slight swelling of the petiole-bases has increased enormously (Fig. 7.); and when in summer the foliage has withered away, these enlarged petiole-bases persist and help to form the singular subterranean stem of our plant. They then remotely resemble beech-nuts in size and shape, but the edges are not so sharp, and the inner side is flat. We can easily recognize them by the triangular, dark brown scar left at the top where the thinner part of the petiole has withered away.

The minute bulblets, which I mentioned above as growing in the axils of the bracts on the elongating axis, do not develop their rudimentary leaf-blades at all, but soon lose nearly every trace of them, retaining only a small incurved point at the top. But their mass increases very considerably, while the axis to which they belong, and at the top of which the real leaves are growing, does not lengthen in proportion, so that at the end of the growing season these bulblets are found crowded under and around the large persisting petiole-bases described above. Their outer sides are not concave, but rather convex (Fig. 2), and in size they vary very much, some being as small as millet or hemp seeds, while others are as large as grains of wheat or even of corn. They have of course no scar at the top, the initial blade of their early stage of development having been absorbed or transformed into a smooth blunt point.

On the ground of these observations we might distinguish two sorts of "granulate bulblets" growing on the root-stock of *Dicentra cucullaria*, viz., 1st, metamorphosed petiole-bases, and 2nd, abortive leaves. Their physiological functions are, no doubt, identical; and, in regard to structure and contents, there is not much essential difference; the bulblets of both kinds contain numerous fibro-vascular bundles scattered through the bulk of large parenchymatic cells that are crowded with starch-granules; but in bulblets of the first kind there are from three to five strong principal fibro-vascular bundles (Figs. 6 and 7) while there are no such fibres in those of the second kind (Fig. 2).

Every one of these bulblets is provided at its base with a bud, which eventually produces a new axis during the next season, while, at the same time, new axial organs spring from the main stem. It is,

therofore, evident, that an old root-stock will form a conglomeration of branches, and will have a coral-like appearance when the bulblets are removed.

It is not quite easy to decide from actual observation, whether the buds morphologically belong to the bulblets, or to the axis on which the latter are inserted. In the former case, we should have one of the rather rare occurrences of abnormal bud-production from petioles. But, I think, we can plainly distinguish a narrow zone of tissue in the bulblet at the point of its insertion, that morphologically belongs to the axis. But this zone, from which the incipient bud is differentiated, is, together with its bulblet, very easily detached from its axis, and then gives rise to a new individual plant.

EXPLANATION OF PLATE XXIII.–(For figure of entire plant see Gray's Struct. Bot. p. 204, where, however, the thin portion of the petiole ought to be represented as proceeding from the *top* of the bulblet.

Fig. 1. longitud. sect. of last year's bulblet with bud at the base (December). Fig 2, cross-sect. of the same.—Fig. 3, the same with elongating axis; *lf*, leaf; *br*, bracts.—Fig.4, longitud. sect. of vigorous shoot (in December) separated from root-stock, the large lower bracts removed; *rt*, root breaking through overlying tissue; *bb*, new bulblets in axils of upper bracts; *pt*, petiole-bases (the blades belonging to them are cut off); *a*, end of axis, all magnified. Fig 5. cluster of bulblets between two bracts (in December), taken from the axil of a lower bract on shoot in Fig. 4. Fig. 6,* sections of petioles in December, and Fig. 7, in April: *a*, longitud. sections showing bud at base; *b*, cross-section from base, *c*, from middle and *d*, from top of thickened portion; *e*, from upper (thin) part of petiole.

New or Little-Known Ferns of the United States. No. 12.

By D. C. EATON.

36. *Polypodium Swartzii*, Baker.—Rootstock very long and slender, chaffy with narrow ferruginous scales; fronds scattered, short-stalked, thin-membranaceous, smooth, oval to linear-lanceolate, ½ to 5 inches long, 3 to 5 lines broad, entire or sinuate; veinlets visible, reticulated, paracostal areoles long and narrow, next ones much larger, oblique, outer ones much smaller and irregular; fertile fronds longer than the sterile, and soriferous on short included veinlets in the largest areoles only, the sori thus in a single row each side of the midrib. Syn. Fil., p. 357. *P. serpens*, Swartz, Mettenius, Hooker, but not the *P. serpens* of Forster.

Climbing on stems of shrubs and small trees, often several feet above the ground; at the north end of Key Largo, Florida; A. H. Curtiss, Feb. 21, 1882.

I have to thank Mr. Davenport for a specimen of this interesting little fern. It was discovered in Santo Domingo nearly two hundred years ago by Plumier, who gave but a slightly exaggerated figure of it under the name of "*Lingua Cervina scandens, angustis et undosis foliis.*" He remarked that the fronds are all drooping because of their very slender stalks. Linnaeus gave no account of this plant; but it has been recognized by most later writers on the West India

* Fig. 6, the lettering of which was accidentally omitted, is to the right of Fig. 7.